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Osga, Dr. Glenn A.

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This article demonstrates the application of an advanced human-computer interface for the future, the multimodal watchstation (MMWS), and how it reduces the human workload, task processing time, errors, and training, enabling significant reductions in manning levels.

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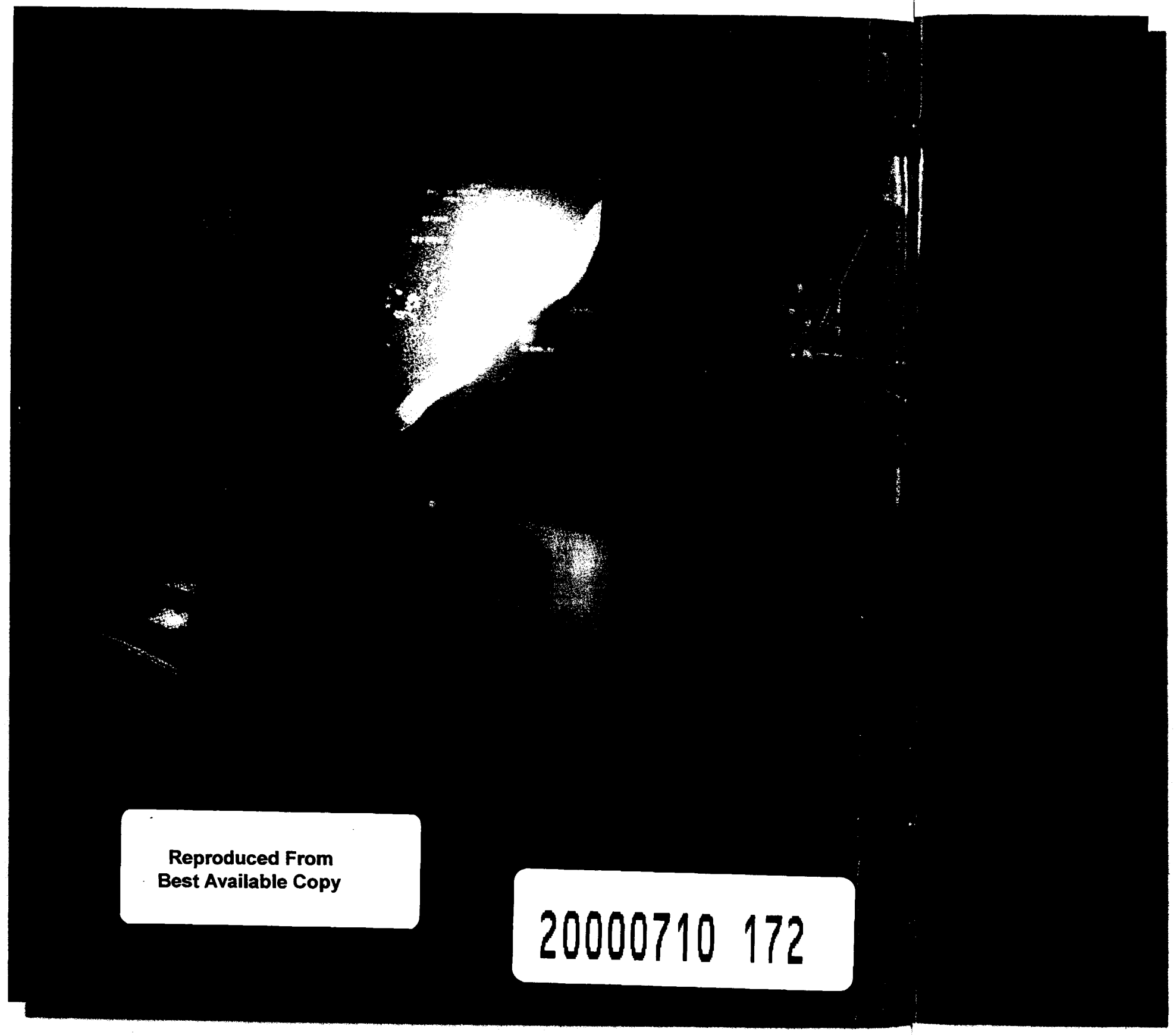
The TASK-CENTRIC Watchstation



SEA OF JAPAN, Sept. 12, 2010—It has been only 32 days since the first Red Country (RC) units made their coordinated incursion over the de-militarized zone (DMZ) to start this conflict. The allies, initially, had given ground, then the RC advancement stopped. And now this newest, 21st-century, DD 21-class ship found herself in the middle of an allied thrust to put the world back where it was in early August.

"Today was going to be an exceptionally busy day," LT Campbell thought to herself, as she sat at her multimodal watchstation (MMWS) or, as the crew called it, *the station.* As leader of the air defense, three-member team and co-leader for land attack in a five-member, warfare operations subgroup, she had supported both air and land-attack missions the previous day, but not on a scale as planned for today.

Coming on watch was easy these days. She remembered the old days on an *Aegis* ship where sitting through briefings and shuffling through papers was the norm. Now she had the information she needed, packaged and delivered to her at the watch briefing. The arrangement of watchstations in a 12-member, fully crewed combat information center (CIC) also allowed her easy face-to-face conversations with her team as they completed the turnover from the night watch. With a voice command she spoke "LT Campbell" and placed a thumb print in the square on the lower center of four flat-panel displays, which launched her station's task-management assistant into action. There were no ID cards to lose or passwords to remember.

Officially, the MMWS labeled the task "situation awareness update" on her task-manager display, but the crew called it the "wake-up call" task. The station summarized events relevant to her job and the planned mission. She liked the way it noted changes since she was last on watch—*No change in ROE* [rules of engagement] ... *Intel on air launches out of land-based installations* ...

by Dr. Glenn A. Osga

(Gloria J. Barry/USN)

... Weather looks good ... Waiting for specific tasking from JTF [joint task force commander] *and ATF* [amphibious task force commander] *in support of Land Attack and Air Defense/Strike Support missions.* "OK," she thought, "today we could really earn our paychecks."

Her thought process was broken momentarily by a voice message coming over her 3-D audio headset. The message originated from the upper right, front area of her station, where she had put the icon on the sound-management graphic display. At the same time, the conversation between her team's IC (information coordinator) and SC (systems coordinator) was easily recognized in 3-D audio space to her front left. The conversation about Track 7433 caught her attention, since it was a downed aircraft just off the RC coast in the operations area where she would be working.

"Play last three voice reports on Track 7433," she spoke to the station. The digital-audio database stored all communications, to be sorted later by sender, destination, time or other topics. A speech analysis technique, called wordspotting, looked for instances of Track 7433 in the multitude of conversations recorded during last night's watch and presented them neatly in an ordered list with graphics showing start and stop points for each audio segment.

She pointed to the screen and said, "play" and heard the first of three conversations about the helo reported missing at 0230 that morning. Gone were the days of hastily writing down notes, making grease pencil marks while conversations ran in real-time (and were then *lost* in time), or annoying repetitions until all listeners had the right track number.

An audio icon sounded from the location of her right side display. No matter that she had momentarily turned her head to the left to talk to the IC. Three-dimensional head tracking, built into the headset, continuously recorded head position and transmitted the alert to her through the stereo headset as if it came from the precise display location. The audio indicated that the anticipated operational tasking was arriving from the joint task force commander. She had already decided to partition her display workspace into areas for land attack (LA) and air defense, anticipating a heavy LA role this watch.

Her task-manager display showed clearly defined graphic timelines for activities related to mission planning, target pairing and weapons launch for designated RC targets. The mission was clear—in preparation for 7th Corps advancements, neutralize as much of the RC-armored units with Tomahawks, Land-Attack Standard Missiles (LASM) and Extended-Range Guided Munition (ERGM) rounds in coordination with air strikes from USS ***Abraham Lincoln*** (CVN 72) Battle Group. The CIC team also was concerned with identification duties for aircraft departing and returning from their battle group, as well as area air-defense for potential RC, surface-to-surface missile launches.

Coordinated strikes were arriving on her land-attack, task-manager display in grouped packages, parsed and set up by the software in organized rows of tasks, spread across the mission timeline. At the same time, she noted an alert icon for Coordinated Strike 9001 and pointed to the task icon for further explanation. Although she knew that automation could handle part of the work, she had to supervise tasks and be ready to jump in to handle problems not resolved by automated assistants. In this case, a forward launcher on an Aegis ship was down, but was assigned to the strike 9001 package calling for a specific Tomahawk by tail number. The mission plan offered an alternate missile launcher but needed her approval as lead coordinator. She decided to check on the current launcher status since there was enough time before this "time-on-target" mission began. At nearly the same time, she noticed the red icon on the systems' status report from the "shooter" vessel turn yellow, indicating that it would be back online at 0730 in plenty of time for the required launch.

The Surface Warfare **Training Vision** is conducting critical and detailed analysis of new WATCHSTATION tasks to develop the proper TRAINING PIPELINES to ensure future surface warriors are ready to RELIEVE the watch.

(Joe Hendricks/USN)

As the task bars continued updating LA mission progress, LT Campbell turned her attention to the air-situation display. The task list for air called for surveillance against any mobile launchers, but her particular concern was the potential air threat against the battle group by RC attack aircraft. Intel reported that an air wing had been moved from the far north to a base near the DMZ. In this littoral zone, reaction times for the RC aircraft involved in the land battle would be short. Suddenly, the RC aircraft begin turning to attack naval forces. Surveying the task manager display, she could see a sequence of steps planned for any hostile, or assumed hostile, aircraft approaching their battle group. Therefore, she knew what the system, including automation settings, would do in this case: "manage by permission" rules were in place. Thus she would be called upon to confirm any defensive launches.

SEA OF JAPAN, 1030, Sept. 12, 2010—*The fifth of 10 planned Tomahawk missiles just launched. An unplanned, but time-urgent, call-for-fire support mission had just arrived from the 31st Marine Expeditionary Unit. LT Campbell's right side display showed the lines of fire with task bars showing the progress of a planned volley of ERGM rounds to GPS (Global Positioning System) coordinates delivered just moments earlier.*

Her brief survey of land-attack support tasking was abruptly broken by an audio message coming from the left display, "unknown air turning inbound." A short time later, the symbol turned into a hostile air threat and continued on a threatening course, not toward them, but to a fleet oiler transiting to the north. The tactical display and task- manager displays showed potential timelines for interception by her own ship's missiles.

The task to vector defensive counter-air (DCA) aircraft from the closest patrol station also showed an alternate mission solution. The TSC (total-ship coordinator) recommended a DCA-vectoring solution to the team since interception was possible in a short time, as depicted in the task-response plan. As WC (warfare coordinator), LT Campbell was responsible for implementing that plan. She pointed to the threatening track symbol and selected the "vector DCA to threat" task. Several things happened:

- An appropriate voice message scripted to the DCA was shown.
- Her display showed a zoomed-in tactical display with the DCA flight solution and time.
- The threatening track's history was shown.
- Possible tasks to illuminate, warn or perform an IFF (identification friend or foe) challenge were shown on the task-manager display, since none were previously done.

She simply could select the message and hear a digitized message with her own voice sent out to the aircraft. The message would be clearly transmitted to the call name of the aircraft with a copy to "Red Crown," an identification supervisor for the battle group, seated just a few feet away.

It was good that she was not tied up in dictating the voice messages. Just then, the embedded naval gunfire assistant notified the system coordinator that a hot hydraulic seal was of concern for the ERGM mission in progress. In response, the NSFS (naval surface fire support) assistant displays showed four options for working around the problem, most of which could maintain the firing rate for the time being. Not wishing to be distracted from his current visual task, the SC acknowledged by voice command to approve the gunfire assistant's recommended course of action. While watching the NSFS-SC interaction on her center display, LT Campbell sent the DCA-vector voice message, responded to the aircraft's acknowledgement, and watched the friend-air symbols change course toward the air-threat's path. In the meantime, the SC authorized the ERGM call-for-fire rounds as prompted by his task-manager display. Two urgent mission requests were addressed quickly by the small team in parallel with a quick assessment of equipment issues.

Changing the CIC Design

Is this "gee whiz" technology just to show that we can do it ... or is it something more fundamental? This futuristic script implies several revolutionary changes from the CIC of today—notably, a flexible structure of cross training and skills not segmented by the submode structure imposed by today's software. Gone are the specialized Tomahawk, gun or Standard missile consoles. Gone are the stovepipe software applications tied one-to-one with a specific console. Gone is the distinction between "decision-maker" and "operator" with their respective software and separate workspaces. The ship information structure and information delivery is supplied to the CIC team in a *task-centric* manner. Key concepts of this task-centric design approach are:

- tailoring information to tasks
- user workload and task management
- streamlining task procedures
- multitasking user support.

If these skills are fundamentally different from the past, where did LT Campbell receive her training? Who was sufficiently competent to develop this new curriculum and deliver it to LT Campbell and her contemporaries with the proper delivery techniques, in the proper sequence and at the proper time? What about the team training that allowed the integration of the other members of the team once they reported aboard their ship? The new Surface Warfare Training Vision is addressing these issues and is conducting critical and detailed analysis of these new watchstation tasks to develop the proper training pipelines to ensure the LT Campbells of the future are ready to relieve the watch.

Editor's note: Dr. Osga is a scientist and human-systems integration business area manager in the Simulation and Human Systems Technology Division of the Naval Warfare Systems Center in San Diego.